WAIPIO HEIGHTS SUBDIVISION - PARK SITE PRELIMINARY SOIL REPORT
(for grading purposes)

WAIPIO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-4-07

To:
COMMUNITY PLANNING, INCORPORATED

By:
WALTER LUM ASSOCIATES, INCORPORATED
CIVIL ENGINEERS
January 31, 1967

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM
EDWARD WATANABE
EZRA KOIKE

1019-A UNIVERSITY AVENUE • HONOLULU, HAWAII • PHONE 990-471

January 31, 1967

MR. GEORGE HOUGHTAILING
Community Planning, Inc.
Suite 602, 810 Richards Street
Honolulu, Hawaii 96813

Dear Mr. Houghtailing:

Subject: Waipio Heights Subdivision - Park Site
Preliminary Soil Report
(for grading purposes)
Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended

In accordance with your request, a preliminary soil exploration was made at the proposed park site for the Waipio Heights Subdivision at Waipio, Ewa, Oahu, Hawaii, Tax Map Key: 9-4-07.

It is proposed that excess material from the Waipio Heights Subdivision - Unit 2 be placed in this area to develop a future park site.

From the field exploration and laboratory test results, it is our opinion that the proposed fills of about 15 ft may be constructed on the site. Light structures can be supported either directly on stiff existing ground or on properly compacted fills constructed from suitable on-site soils. For heavy structures or buildings 3 or more stories in height, additional soil investigations should be made at each building site.

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas. These situations will have to be adjusted and corrected in the field as they are detected.

All earthwork should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.

The report includes a boring location plan, boring logs, laboratory tests and recommendations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike

Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:vi

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WAIPIO HEIGHTS SUBDIVISION - PARK SITE PRELIMINARY SOIL REPORT
(for grading purposes)

WAIPIO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-4-07

SCOPE OF EXPLORATION

The purpose of this exploration was to determine soil conditions of the proposed park site for the Waipio Heights Subdivision at Waipio, Ewa, Oahu, Hawaii for grading purposes.

It is proposed that excess material from the Waipio Heights Subdivision - Unit 2 be placed in this area to develop a future park site.

This report includes field exploration, laboratory tests and recommendations regarding the native soils at the site.

FIELD EXPLORATION

Five borings were made at the site. The locations of these borings are shown on Figure 1, Boring Location Plan. Descriptions of the underlying soils are shown on the Boring Logs Nos. 1 thru 5.

Both disturbed and exploratory thin-wall-tube samples were taken during the boring operation. Soil samples were visually identified and tentatively classified in the field. In the laboratory, they were subjected to appropriate tests. The field identifications and classifications were

then reviewed and modified to conform with the results of the laboratory tests in accordance with the "Unified Soil Classification System."

LABORATORY TESTS

Laboratory tests included: in-place natural density, moisture content and unconfined compression; Atterberg limits; specific gravity; gradation; expansion and CBR.

A list of the standard field and laboratory test methods used for this project is attached.

A summary of the laboratory test results is given in Table IA.

SITE AND SOIL CONDITIONS

The project site is located east of Crestview Subdivision and north of Waipio Heights Subdivision Unit 2.

The site is an abandoned field covered with wild sugar cane and shrubs. Maintenance roads and irrigation ditches were not evident because of the heavy overgrowth on the site. A stream runs along the north boundary.

The land generally slopes downward from northwest to southeast at grades varying from 10 to 15%.

Borings and laboratory tests indicated a surface layer of about 2 to 8 ft of medium to stiff, reddish-brown and brown silty clay underlain by decomposed rock or boulders. At the northern end of the site, decomposed rock and boulders were exposed at the ground surface.

No seepage or ground water was noted during the field exploration. If ground water is detected during excavation, care should be taken that these conditions are evaluated and the area properly drained before the construction of fills.

In general, the excess material from the Waipio Heights Subdivision - Unit 2 will be used to construct fills on this site. In the opinion of the Soil Engineer, the on-site soils have sufficient strength to support the proposed low fills (about 15 ft) and light structures.

DISCUSSION AND RECOMMENDATIONS

Fills

In general, the soils from the Waipio Subdivision - Unit 2 are suitable for the construction of the proposed fills. The construction of the proposed low fills should be done as required by the Revised Ordinances of Honolulu, 1961 As Amended; and as recommended below:

1. After the clearing and grubbing, all topsoil should be either (a) stripped to stiff natural ground or (b) scarified and recompacted before the placement of fill.

2. All hard surfaces along existing maintenance roads should be scarified and recompacted to a density that matches the density of the surrounding soils.

3. If irrigation ditches are encountered where fills are proposed, all loose material along the bottom and sides of the ditches

should be stripped down to stiff natural ground; the lining of ditches should be removed; and the fill in the ditches should be compacted to such densities that match the densities of the surrounding soils.

4. Subdrains should be provided along the bottom of natural drainageways before placing any fill. The locations of subdrains should be verified in the field after clearing and grubbing and during the earth moving operations.

5. All fills should be constructed in approximately level layers starting at the lower end and working upward.

6. All fills should be laid in 6-in. compacted layers that are at least 90% of AASHO T-180-57 density.

Slopes

Cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

The proposed low slope heights (top to toe) of about 15 ft should result in satisfactorily stable slopes.

Slope adjustments or other precautions may be necessary if seepage zones or soft spots are encountered in localized areas.

For protection against erosion during construction, it is recommended that runoff water from rainstorms be controlled by berms or other approved methods.

The surface of fill slopes should be compacted with a sheepsfoot roller or by cat-tracking.

Slope planting is recommended on cut and fill slopes to minimize erosion. For additional information, see the attached "Proposed Specification for Planting."

Foundations

If earthwork is carried out in the specified manner, the stiff natural ground and properly constructed fill should develop adequate bearing values to support light structures. Recommendations for foundation construction are:

1. Bearing values for a given soil usually vary with the size and depth of the footings. For light structures, bearing values of 2000 p.s.f. on compacted fills and 3000 p.s.f. on stiff undisturbed ground may be used.

2. For heavy structures or structures of 3 or more stories in height, the bearing values should be re-evaluated for each building site.

3. Because of the downhill creep effect of soils on a slope, some settlement may occur near the tops of slopes. Therefore, for slopes of about 15 ft or more, buildings should be placed about 15 ft from the tops of slopes. This distance may be reduced for lower slope heights, e.g., 10 ft for 10-ft-high slopes.

4. Construction of retaining walls on side slopes should be avoided unless the underlying materials are very stiff or hard.

5. Good surface drainage away from the foundations of the proposed structures should be maintained.

Roadway

If the low expansion materials are used within the top 2 ft of finish grade, for the light traffic anticipated, a rough estimate is as follows:

1. Wearing course: 2 in. asphaltic concrete.
2. Base course: 6 in. base course directly over a prepared subgrade.

Local adjustments regarding subbase requirements can be made in the field in accordance with the design standards of the City and County of Honolulu as soil conditions are encountered in the field at subgrade levels.

It is recommended that the subgrades of roadways be shaped to drain. Outlets should be placed at low points of roadway profiles to avoid water pocketing by running bleeder pipes into catch basins at low points of the subgrade.

PROPOSED SPECIFICATION FOR EARTHWORK

WAIPIO HEIGHTS SUBDIVISION - PARK SITE

General Description

This item shall consist of all clearing and grubbing, removing of existing structures, preparing of land to be filled, filling of the land, spreading, compacting and testing of the fill, and all subsidiary work necessary to complete the grading of the filled areas to conform with the lines, grades and slopes as shown on the accepted plan.

Clearing, Grubbing and Preparing Areas to be Filled

All vegetation and rubbish shall be removed, piled and burned or disposed of leaving the disturbed areas with a neat, debris-free appearance.

All vegetable matter shall be removed from the surface upon which fill is to be placed. All topsoil and stockpiled soils shall be (1) stripped to stiff natural ground or (2) scarified and recompacted. All topsoil encountered at finish grade shall be scarified and recompacted.

Subdrains shall be provided along the bottom of natural drainageways before placing any fill. The locations of subdrains should be verified in the field after clearing and grubbing and during the earth moving operations.

All hard surfaces along the existing access roads shall be scarified down to stiff soils to match the densities of the surrounding soils.

Where fills are made on the sloping areas steeper than 5 horizontal to 1 vertical, the ground at the toe of the slope shall be benched to a generally level condition. As the fill is brought up, it shall be continually

keyed into the stiff natural ground by cutting steps into the hillside and compacting the fill into these steps. Ground slopes which are flatter than 5 horizontal to 1 vertical shall be benched when considered necessary by the Soil Engineer.

Materials

Fill material shall consist of soils approved by the Soil Engineer from the Waipio Unit 2 Subdivision. The soils shall contain no more than a trace of organic matter and no particles larger than 6 in. in diameter. Also, it shall contain not more than 40% gravel (#4 sieve to 3 in. sieve sizes) and not more than 10% cobbles larger than gravel and smaller than 6 in. in diameter. Fill material placed in the top 2 ft of fills shall contain not more than 30% gravel and any material larger than gravel.

Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and thoroughly blade-mixed during the spreading to insure uniformity of material and uniformity of moisture content in each layer.

No rocks or cobbles shall be allowed to nest and all voids between rocks must be carefully filled and compacted with small stones or earth.

When the moisture content of the fill material is below that specified by the Soil Engineer, water shall be added until the moisture content is as specified and assures a thorough bonding during the compacting process.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to not less than 90% of maximum density in accordance

with AASHO Test No. T-180-57 or other density tests which will obtain comparable results. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers. Rollers shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified moisture content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to insure that the desired density has been obtained.

Field density tests of the compaction of each layer or fill shall be made by the Soil Engineer. Where sheepsfoot rollers are used, soil may be disturbed to a depth of several inches; therefore, density readings shall be taken below the disturbed surface as often as necessary as determined by the Soil Engineer. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, the particular layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Soil Engineering Services

The Soil Engineer shall observe the filling and compacting operations and make necessary tests in accordance with the guide specifications.

Rainy Weather

No fill material shall be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the Soil Engineer indicate that the moisture content and density are as previously specified.

PROPOSED SPECIFICATION FOR PLANTING

WAIPIO HEIGHTS SUBDIVISION - PARK SITE

Planting materials shall be hunnan grass, buffalo grass, and manienie. In damp areas where manienie will not thrive, hunnan grass shall be planted and in shaded areas, buffalo grass shall be planted.

Planting materials shall be obtained by digging up luxuriant growths from areas that are free of seeds, roots, plants, and grasses that are objectionable. Plant and water within 24 hours after digging from original growing position.

Grasses for planting shall be in approximately 4 in. runners. Planting shall be done in staggered rows 12 in. apart over topsoiled areas. After planting, cover with additional 1/2 in. topsoil. Flat areas shall be rolled with a lawn roller. Water soon after planting, continue daily until growth is sufficient that complete cover has been achieved. In any area where grasses do not become established, runners shall be replanted.

Apply 10-10-2 fertilizer after 2 to 3 months at the rate of 800 lb per acre. Initial maintenance shall be continued until stabilization has been reached.

PROPOSED SPECIFICATION FOR BASE COURSE

WAIPIO HEIGHTS SUBDIVISION - PARK SITE

Materials

The base course for use under floor slabs shall consist of clean crushed rock, gravel, coral, cinders or other material as approved by the Soil Engineer. It shall be free from adobe, organic matter, and other such deleterious substances.

Grading

The base course material shall have the following gradation:

Sieve	% Passing
2" Sq.	100%
#4	0

Compacting

The base course material shall be thoroughly compacted with vibratory or other approved equipment.

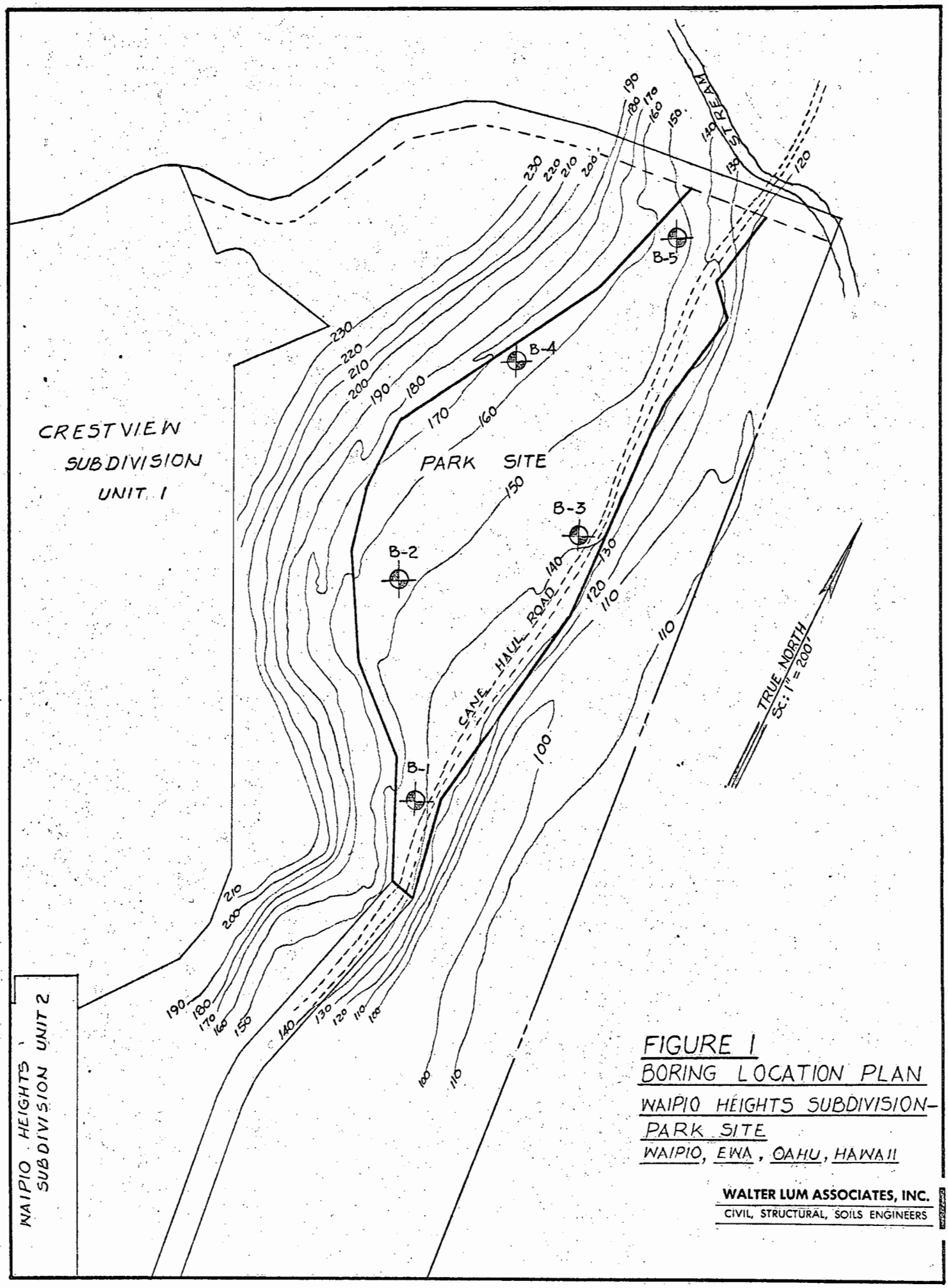

FIGURE 1

BORING LOCATION PLAN

WAIPIO HEIGHTS SUBDIVISION-PARK SITE

WAIPIO, EWA, OAHU, HAWAII

WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM ASSOCIATES 1019—A UNIVERSITY AVENUE • HONOLULU, HAWAII 96814 • PHONE: 990-471

Boring Log

PROJECT WAIPIO HEIGHTS SUBDIVISION-PARK SITE

LOCATION WAIPIO, EWA, OAHU, HAWAII

HAMMER:

Weight 10 lb. SLEDGE HAMMER

Drop –

SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 1 Sheet No. 1 of 1

Driller WALTER LUM ASSOC. Date 12-15-66

Field Party GLORY, OSHIRO, MEYERS

Type of Boring AUGER (McCULLOCH) Diam. 3"

Elev. 143'± * Datum

Water Level				
Time	–			
Date	12-15-66			

UNIFIED SOIL CLASSIFICATION	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot 0 10 20 30 40	2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 143'± *										
ML	MEDIUM TO STIFF REDDISH BROWN SILTY CLAY	0		1-A	119.0	28	93.3	7810	–		5/5', 8/5',
	MOTTLED BROWN DECOMPOSED ROCK			1-B	–	32.4	–	–	–		15/5', 7/3',
	STOPPED BY ROCK OR BOULDER	5									

* ELEVATION ESTIMATED FROM CONTOUR PLAN

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Boring Log

PROJECT WAIPIO HEIGHTS SUBDIVISION—PARK SITE

LOCATION WAIPIO, EWA, OAHU, HAWAII

HAMMER:

Weight 10 lb. SLEDGE HAMMER

Drop –

SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 2 Sheet No. 1 of 1

Driller WALTER LUM ASSOC. Date 12-15-66

Field Party GLORY, OSHIRO, MEYERS

Type of Boring AUGER (McCULLOCH) Diam. 3"

Elev. 153'± * Datum

Water Level	NOT ENCOUNTERED			
Time	–			
Date	12-15-66			

UNIFIED SOIL CLASSIFICATION	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot 0 10 20 30 40	2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 153'± *	0									
ML	MEDIUM TO STIFF REDDISH BROWN SILTY CLAY	5		2-A	121.5	27	95.5	9110	–		8/.5' 8/.5'
				2-B	128.0	27	100.5	5420	–		10/.5' 10/.5'
MH	STIFF, BROWN SILTY CLAY	10		2-C	131.8	26	104.9	–	–		15/.5' 15/.2'
		15		2-D	134.7	27	105.7	7810	–		40/.5'

* ELEVATION ESTIMATED FROM CONTOUR PLAN

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Boring Log

PROJECT WAIPIO HEIGHTS SUBDIVISION-PARK SITE

LOCATION WAIPIO, EWA, OAHU, HAWAII

HAMMER:

Weight 10 lb. SLEDGE HAMMER

Drop –

SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 3 Sheet No. 1 of 1

Driller WALTER LUM ASSOC. Date 12-15-66

Field Party GLORY, OSHIRO, MEYERS

Type of Boring AUGER (McCULLOCH) Diam. 3"

Elev. 141' ± * Datum

Water Level	NOT	ENCOUNTERED		
Time	–			
Date	12-15-66			

UNIFIED SOIL CLASSIFICATION	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot 0 10 20 30 40	2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 141' ± *	0									
ML	MEDIUM TO STIFF REDDISH BROWN SILTY CLAY			3-A	119.0	28	92.8	6770	–		7/.5' 11/.5'
		5		3-B	125.3	26	99.4	13,000	–		16/.5' 17/.5'
				3-C	127.1	27	99.9	13,000	–		6/.5' 12/.5'
	MEDIUM TO STIFF MOTTLED BROWN, SILTY CLAY W/ DECOMPOSED ROCK										
		10		3-D	–	39	–	–	–		11/.5' 16/.5'
	STOPPED BY ROCK OR BOULDER										

* ELEVATION ESTIMATED FROM CONTOUR PLAN

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Boring Log

PROJECT WAIPIO HEIGHTS SUBDIVISION-PARK SITE
LOCATION WAIPIO, EWA, OAHU, HAWAII

BORING NO. 4 Sheet No. 1 of 1
Driller WALTER LUM ASSOC. Date 12-16-66
Field Party GLORY, OSHIRO, MEYERS
Type of Boring AUGER (McCULLOCH) Diam. 3"
Elev. 164'± * Datum

HAMMER:
Weight 10 lb. SLEDGE HAMMER
Drop –
SAMPLER: 2" O.D. THIN WALL TUBE

Water Level				
Time	–			
Date	12-16-66			

UNIFIED SOIL CLASSIFICATION	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER — Blows Per Foot 0 10 20 30 40	BLOWS/0.5'
	ELEV. = 164'± *	0									
ML	SOFT TO MEDIUM REDDISH BROWN SILTY CLAY			4-A	81.0	34	60.7	–	–		PUSH / 1.0'
		5		4-B	105.7	41	75.2	1990	800		4/.5' 4/.5'
	STOPPED BY ROCK OR BOULDER			4-C	114.3	40	81.8	1460	440		6/.5' 7/.1'

* ELEVATION ESTIMATED FROM CONTOUR PLAN

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Boring Log

PROJECT WAIPIO HEIGHTS SUBDIVISION-PARK SITE

LOCATION WAIPIO, EWA, OAHU, HAWAII

HAMMER:

Weight 10 lb. SLEDGE HAMMER

Drop –

SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 5 Sheet No. 1 of 1

Driller WALTER LUM ASSOC. Date 12-16-66

Field Party GLORY, OSHIRO, MEYERS

Type of Boring AUGER (McCULLOCH) Diam. 3"

Elev. 154'± * Datum

Water Level	NOT ENCOUNTERED			
Time	–			
Date	12-16-66			

UNIFIED SOIL CLASSIFICATION	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot 0 10 20 30 40	2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 154'± *	0									
ML	MEDIUM TO STIFF REDDISH BROWN SILTY CLAY			5-A	115.1	27	90.6	2550	–		5/.5' 9/.5'
		5		5-B	116.5	26	92.4	7810	–		7/.5' 7/.5'
MH	VERY STIFF, REDDISH BROWN SILTY CLAY			5-C	124.7	23	101.8	13,000	–		30/.5'

* ELEVATION ESTIMATED FROM CONTOUR PLAN

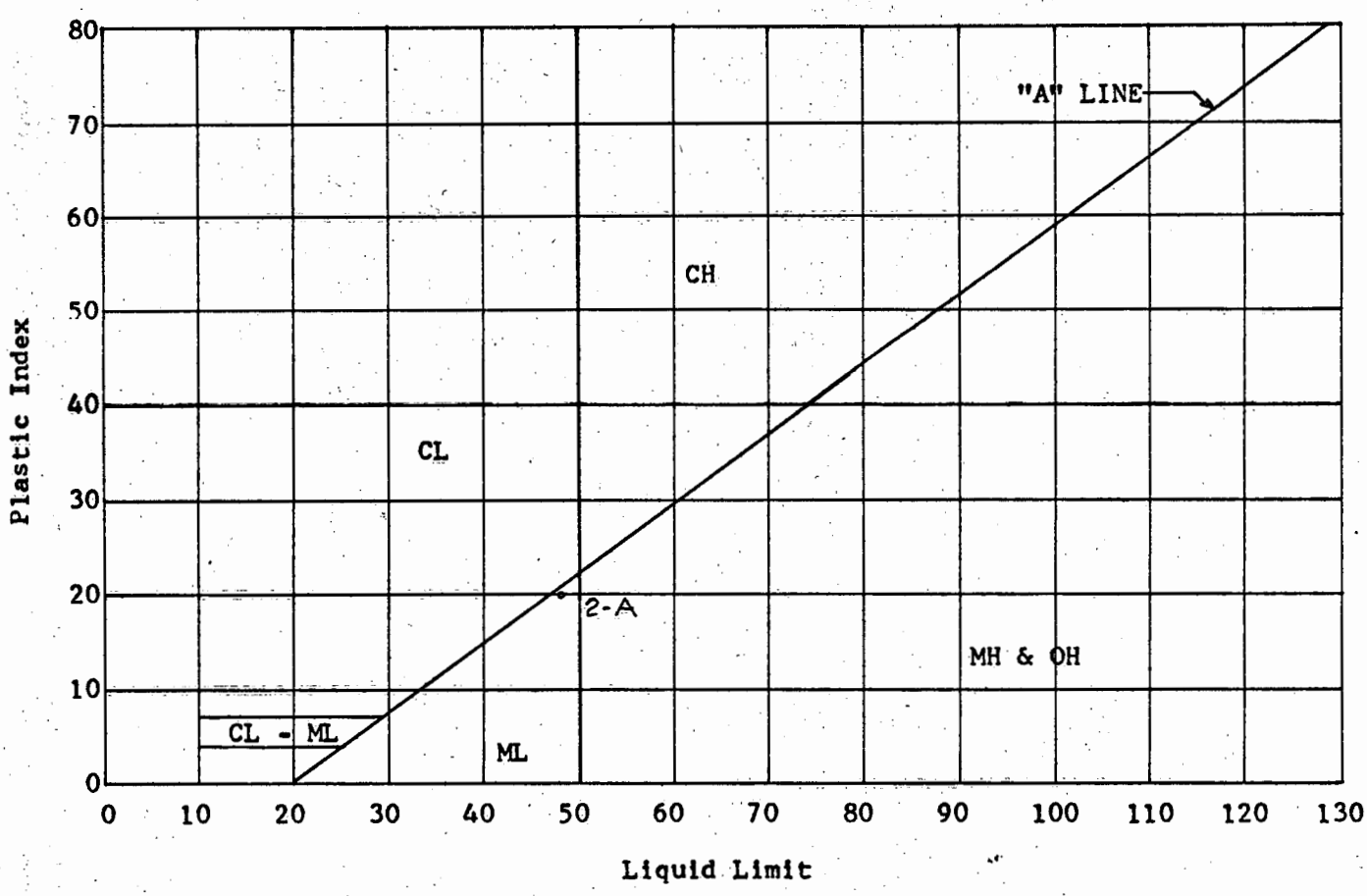
WAIPIO HEIGHTS SUBDIVISION-PARK SITE

TABLE I-A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	2				
SAMPLE NO.	A				
DEPTH BELOW SURFACE	SURFACE				
DESCRIPTION	REDDISH BROWN SILTY CLAY				
GRADING ANALYSIS (% Passing)					
Sieve					
1"	100.0				
½"	100.0				
#4	98.6				
#10	98.3				
#20	98.0				
#40	97.6				
#100	96.9				
#200	96.4				
ATTERBERG LIMITS					
Air Dried or Natural	NATURAL				
Liquid Limit	48				
Plastic Limit	28				
Plasticity Index	20				
Dilatancy	VERY SLOW				
Toughness	MEDIUM				
Dry Strength	MEDIUM				
UNIFIED SOIL CLASSIFICATION	ML				
SPECIFIC GRAVITY	2.85				
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)					
Molding Moisture Content, %	26.0				
Molding Dry Density, P.C.F.	99.0				
Swell upon saturation, %	0.5				
CBR at 0.1" Penetration (%)	7.9				
COMPACTION TEST					
(AASHO T-180-57 Method A)	A				
Dry to Wet or Wet to Dry	DRY TO WET				
Max. Dry Density (P.C.F.)	102.5				
Optimum Moisture (%)	25.0				

JOB: WAIPIO HEIGHTS SUBDIVISION – PARK SITE

LOCATION: WAIPIO, EWA, OAHU, HAWAII



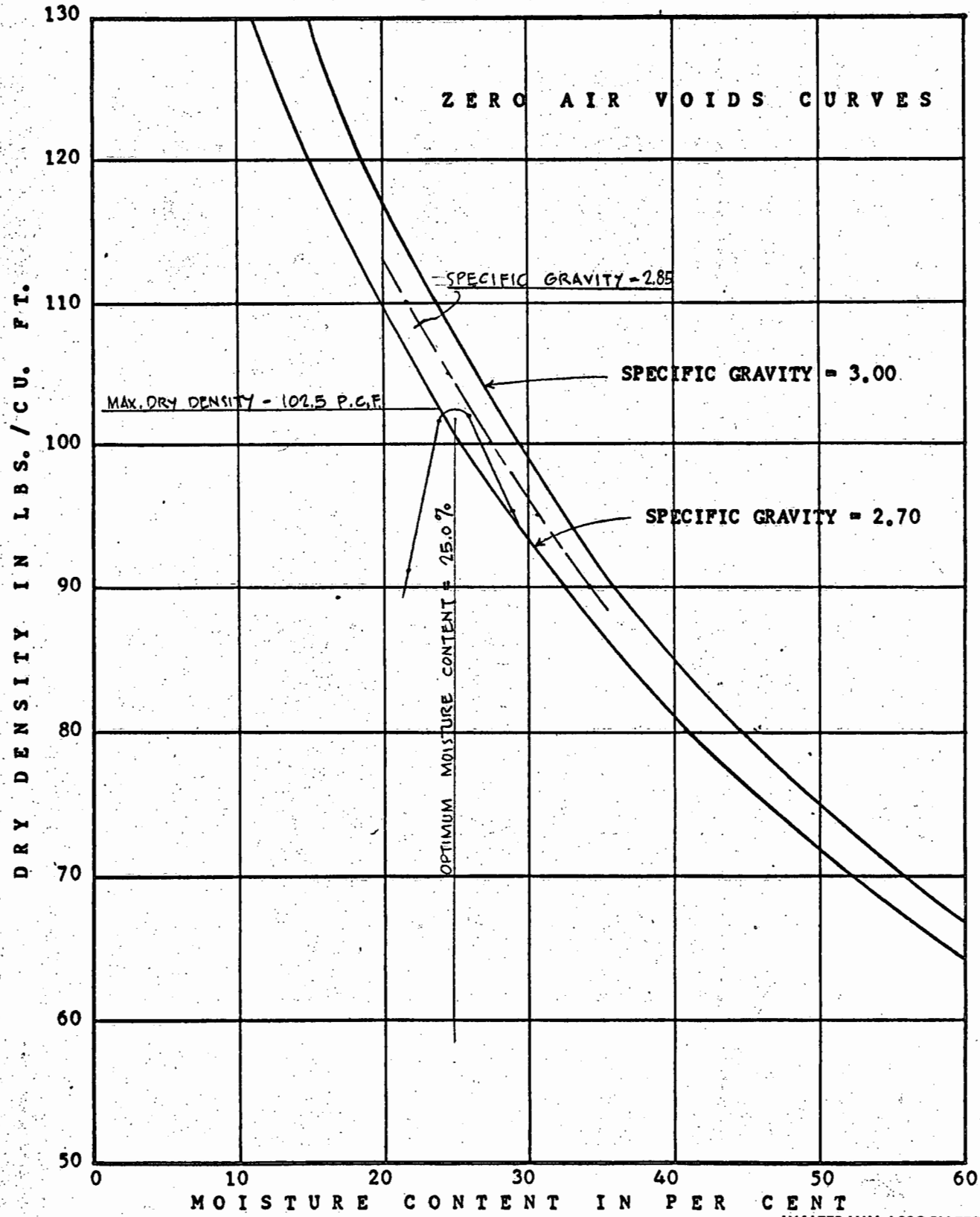
PLASTICITY CHART

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

JOB: WAIPIO HEIGHTS SUBDIVISION – PARK SITE

LOCATION: SAMPLE #2A – SURFACE

DESCRIPTION: REDDISH BROWN SILTY CLAY



MOISTURE-DENSITY CURVE (AASHO T-180-57)

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DATE

BY

GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)	ASTM Designation: D 1452-63T
Method for thin wall tube sampling of soils (Tentative)	ASTM Designation: D 1587-63T
Method for penetration test and split barrel sampling of soils (Tentative)	ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse aggregates	AASHO Designation: T 27-60
Amount of material finer than No. 200 sieve in aggregate	AASHO Designation: T 11-60

Atterberg Limits

Determining the liquid limit of soils Modified as follows: Substitute Casagrande grooving tool. Tests conducted from natural moisture content unless noted otherwise.	AASHO Designation: T 89-60
Determining the plastic limit of soils	AASHO Designation: T 90-56
Calculating the plasticity index of soils	AASHO Designation: T 91-54

Specific Gravity

Specific gravity of soils Modified as follows: 500 ML Pycnometer	AASHO Designation: T 100-60

Expansion and CBR Tests

Expansion test and California Bearing Ratio (CBR)	Section VIII - TM 5-530 "Materials Testing" by Headquarters, Dept. of the Army

Compaction Test

Moisture-Density relations of soils using a 10# rammer and an 18" drop	AASHO Designation: T 180-57

Unified Soil Classification

Designation E-3 from "Earth Manual" by the United States Department of the Interior Bureau of Reclamation